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TOPOGRAPHIC FORMS OF THE UNITED STATES.

BY

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During the past quarter of a century the topographic branch of the United States Geological Survey has been actively engaged in making a detailed map of the United States. In this time it has surveyed 872,000 square miles, or nearly 30 per cent. of the area of the country, and the results have been published on about 800 separate atlas sheets. These are about 13 by 17 inches in dimensions, and each represents from 225 to 900 square miles, according to its scale. This work has now progressed to the point where typical portions of the varied topographic features of the United States have been mapped, and from an inspection of them we may gain an insight into the physiography of our continent.

A study of the country with these maps in hand creates a new interest in the natural features which surround us. It is one thing to look at a beautiful flower; it is quite another to dissect it and to analyze and discover the framework which gives it form and permits its classification. In the same way a new interest is developed in the examination of the scenery of a region, when its topography has been interpreted and classified in the light of an analysis of the underlying rocks which give it form. Especially is this true for the teacher, who gains thus an experience which gives his subject a vividness to be gained in no other school.

The mapping has so far been prosecuted chiefly in those portions of the United States in which economic minerals and rocks may be sought. This includes the mountains of New England and the Appalachian Mountains of the Middle and Southern States; portions of Michigan, Arkansas, and Texas; and the areas in which silver and gold and their associated metals are found in the Far West. Also, some special areas in which particular investigation has been made regarding the value of lands for agricultural purposes; or as producers of forests; or in connection with the development of irrigation. From these initial regions the mapping is now being extended into all portions of the United States.

The essential feature of these maps is that which represents topographic form, or, as it is more commonly called, the surface relief. This is by lines of equal elevation called "contour lines." These express uniform differences of elevation in terms of their horizontal projection on a map surface. Consequently, the distances between them in plan give the slopes and grades of the surface forms. The base to which these differences of height are referred is the mean level of the sea. The shore-line marked by the ocean is the zero of elevation, or the zero contour line. If the contour interval is, for example, 50 feet, you may imagine the height of the surface of the ocean raised by that amount and its shore-line re-mapped. This line will be the 50 feet contour line, every point upon it having that elevation above the level of the sea. If now the sea were raised 50, 100, and 150 feet, etc., and its successive shore-lines mapped, the result would be a topographic map having a contour interval of 50 feet. By observing the horizontal distance apart of these contour lines, an idea of the steepness of the various slopes is obtained. Thus if two 50-foot contour intervals occur in a mile horizontally, the slope is 100 feet to the mile. If the same number occur in a quarter of a mile horizontally, the slope is four times as steep, or 100 feet in a quarter of a mile, etc.

The various topographic forms found on the surface of the earth have been aptly described as "expressing geologic structure, much as the outlines of the human body express anatomical structure." Accepting this as true, it is obvious that the classification and interpretation of such forms require a knowledge of the origin of the rock structure underlying a given region and the agencies which have acted upon its surface. The processes which have produced the various topographic forms are called physiographic, and physiography has been well defined as "a description of the surface features of the earth." Accordingly, the study of physiography includes an explanation of the origin of topographic features.

Physiographic processes may be divided into two great classes, according as they have been produced by agencies which are constructive or destructive. An example of the former is a volcanic cone built of ejecta from the vent of a volcano. An example of the latter is to be found in the cliffs bordering the ocean, which are washed and worn away by wave action.

The constructive agencies which leave the most evident marks upon the surface of the earth in topographic forms are those due—1, to diastrophic action, by which regions sink and rise; 2, to volcanic action; and 3, to deposition, as from water carried in overloaded streams or gravel deposited from glaciers. The more important destructive agencies are—1, Those due to aqueous erosion, as from flowing water; 2, those due to aerial erosion, as wind-bórne sand abrasion; 3, those due to corrasion, which is a wave or glacial action; and 4, those due to disintegration resulting from frost, chemical action, etc. Aqueous agencies are those chiefly potent in shaping topographic forms. The effects of these are so commonly seen as to have gained them the name of regular forms, while those forms resulting from other agencies have been called irregular.

The massive features produced by the great constructive and destructive agencies are finally eroded into the more familiar topographic forms with which we are acquainted. This modelling takes various forms, due—1, To the character and hardness of the rock; 2, to the geologic structure or position of bed-rock; 3, to the slope of the surface; 4, to climatic conditions; 5, to accidents during development; and 6, to the length of time during which the eroding agencies have acted.

Among the more important constructional forms due to the action of diastrophism and illustrated in the topographic maps of the United States are the following:

Emerged plains are illustrated in the coastal plains shown on the Goldsboro, N. J., and Leonardtown, Md., sheets. In the latter case erosion has considerably modified the more level form which the plain had immediately upon emergence; Plateaux are illustrated on the Charleston, W. Va., sheet, Cañon de Chelly, Ariz., and Lamar, Col., sheets. The former have both been highly eroded, while the latter, which is of more recent origin shows less the effects of weathering; Block and massive mountain ranges are illustrated on the Abajo, Utah, and La Plata, Col., sheets; Lake basins and lacustrine plains are illustrated on the Diaster, Nev., and Lassen Peak, Cal., sheets.

Of constructional forms due to the action of volcanism excellent examples are those illustrated in the lava plains of the Bisuka, Idaho, and of the Mt. Taylor, N. Mex., sheets. Also the volcanic cones in the neighbourhood of Mt. Shasta, Cal.

Among the more important gradational forms illustrated in the topographic maps of the United States, and which are due to the action of water, are the following: Alluvial cones are shown admirably on the Cucamonga, Cal., sheet. Alluvial plains are illustrated on the same sheet and on Fargo, N. Dak., also in the built-up valley lands of the lower Mississippi on the Donaldsonville sheet. Wash plains are shown on the Brackett, Tex., and Camp Mojave, Cal., sheets.

Of the aggradational forms produced by ice excellent examples are some of the following: The drumlins and moraines of central New York shown on the Syracuse sheet; those of Wisconsin on the Sun Prairie and Eagle sheets.

Terminal moraines and glacial plains and drift sheets are shown on the Marion, Ia., sheet.

Gradational forms resulting from wind action are well illustrated in the sand dunes of the Provincetown, Mass., sheet, the Coos Bay, Ore., and Kearney, Nebr., sheets. Those due to action of degradation are well illustrated in the sculptured forms, resulting from the erosive action of water. Examples of these are the dissected plateaux of the Fort Payne, Ala., and Charleston, W. Va., sheets.

Residual forms left after the removal of surrounding materials by erosive action of water are excellently shown in the mesas on the Marsh Pass, Ariz., and East Tavaputs, Utah, sheets. The same are shown in the massive mountain ranges throughout the country, and especially in the monadnocks or massive rocky hills, which, because of their hardness, have been left standing after erosion has removed their surrounding envelopes. An example of the latter is Mt. Monadnock, New Hampshire.